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Name: _____; Country: _____

**4th International Mathematics and Science Olympiad
(IMSO) for Primary School 2007**

EXPERIMENTAL EXAMINATION

(120 MINUTES)



Name	Country

**Jakarta, Indonesia
Wednesday, 14 November 2007**

Name: _____; Country: _____

FUN WITH DIGITALS

Mrs. Ana is driving her new car which is equipped with a good safety system. The engine of the car can only be started if *its doors are locked* and *the seat belt is fastened*. If both conditions are not fulfilled, the engine cannot be started. In science, these conditions are described as the **“AND”** logic.



Many buildings are equipped with fire detection alarm system. The alarm will be automatically turned on if *the system detects smoke*, **or** *the fire alarm button is pushed*. The alarm will turn on if at least one of the above conditions is fulfilled. In science, these conditions are described as the **“OR”** logic.



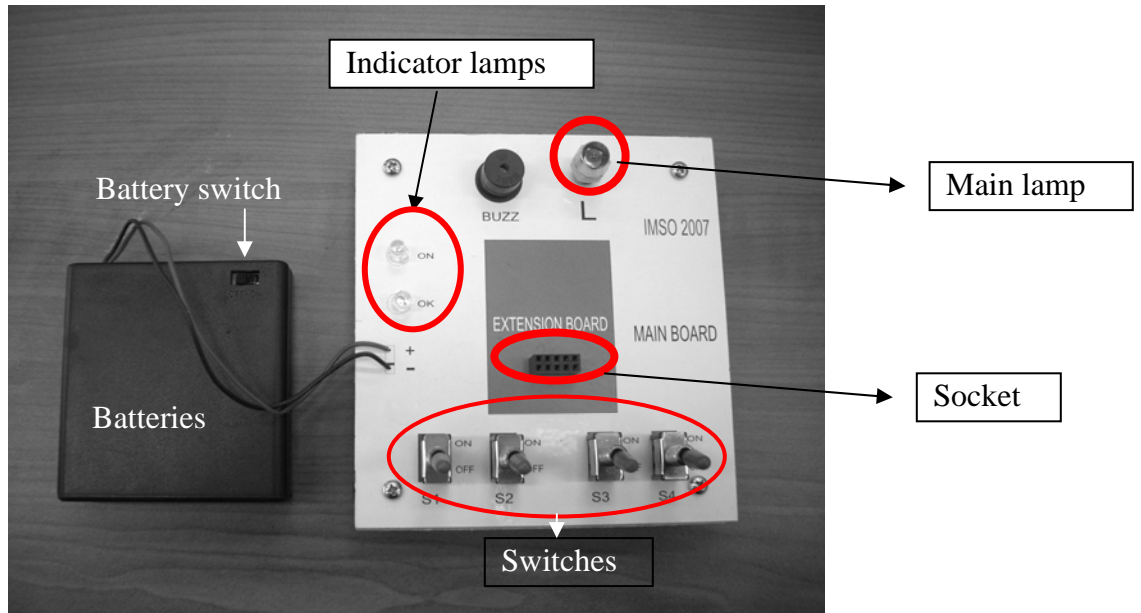
There are many electric appliances such as lamps, refrigerators, TV and so on in our homes that are equipped with *switches* to turn them *on* and *off*. If the switch is in the **ON** position, those appliances will turn on because electric current can flow through them.

Now, we shall play with circuit board. The lamp will be turned on and off with the help of digital circuits with **“AND”** logic and **“OR”** logic principles using switches.

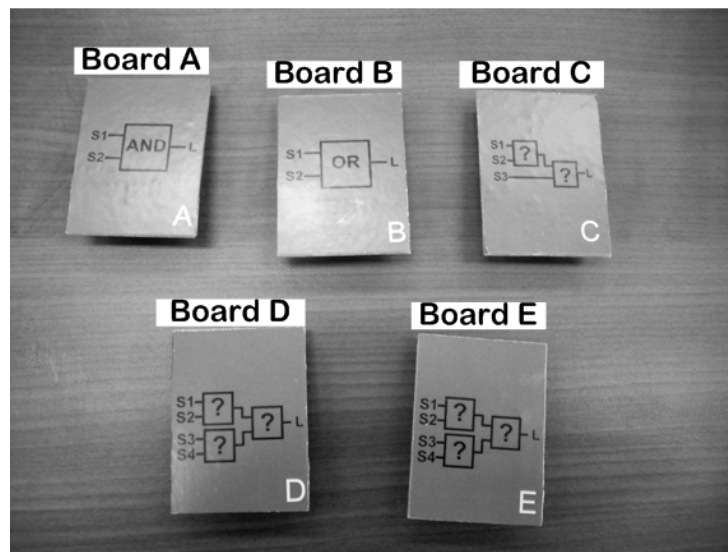
Name: _____; Country: _____

Provided electronic kits:

1. One set of main board consisting of :
 - a. a socket for extension board
 - b. a main lamp (actually it is a LED, light emitting diode)
 - c. indicator lamps (LEDs)
 - d. four switches (S1, S2, S3, “AND” S4)
 - e. a buzzer
 - f. batteries in a black box



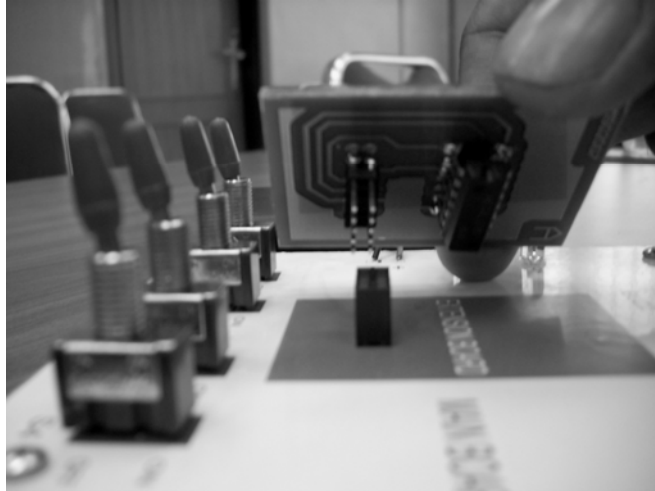
2. Five extension boards (logic boards):



Name: _____; Country: _____

ACTIVITY 1

1. Plug the pins found at the bottom of Board A (“**AND**” logic) into the socket on the main board properly (see the picture below).



2. Switch on the batteries. Batteries are working properly if the red indicator lamp lights up.
3. The logic board is working properly if the green indicator lamp lights up.
4. In this activity, you will have to change the positions of S1 and S2 switches to ON or OFF according to the Table 1 below. Do not use **S3 and S4**.
 - Write “ON” in the Main Lamp column (L) if the main lamp lights up,
 - Write “OFF” in the Main Lamp column (L) if the main lamp does not light up.

Table 1. Board A (AND)

No.	S1	S2	Main Lamp (L)
1	OFF	OFF	
2	OFF	ON	
3	ON	OFF	
4	ON	ON	

(Total Score 4)

5. When you have completed Table 1, switch off the batteries.

Name: _____; Country: _____

ACTIVITY 2

1. Remove Board A and plug in Board B (**OR logic**).
2. Repeat Activity 1.

Table 2. Board B (OR Logic)

No.	S1	S2	Main Lamp (L)
1	OFF	OFF	
2	OFF	ON	
3	ON	OFF	
4	ON	ON	

(Total Score 4)

Question 1:

From Tables 1 and 2, what is your conclusion on how the “AND” logic and the “OR” logic work?

Answer:

(Score 4)

ACTIVITY 3

You are requested to find the unknown logics (X1 and X2) on the Board C.

1. Remove Board B and plug in Board C.
2. Repeat Activity 1 by using S1, S2 and S3 only. Do not use S4.

Name: _____; Country: _____

Table 3. Board C

No.	S1	S2	S3	Main Lamp (L)
1	OFF	OFF	OFF	
2	OFF	OFF	ON	
3	OFF	ON	OFF	
4	OFF	ON	ON	
5	ON	OFF	OFF	
6	ON	OFF	ON	
7	ON	ON	OFF	
8	ON	ON	ON	

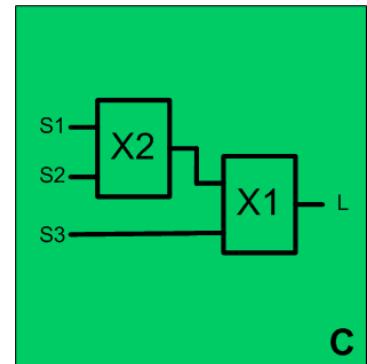
(Score 4)

Question 2:

Use Table 3 to answer the following questions:

(a) What is the logic of **X1**, is it “AND” or “OR”? Explain your answer.

(Score 2)



(b) What is the logic of **X2**, is it “AND” or “OR”? Explain your answer.

(Score 2)

Name: _____; Country: _____

ACTIVITY 4

You are requested to find the unknown logics (X3, X4 and X5) on Board D.

1. Remove Board C and plug in Board D.
2. Repeat Activity 1 by using S1, S2, S3 and S4.

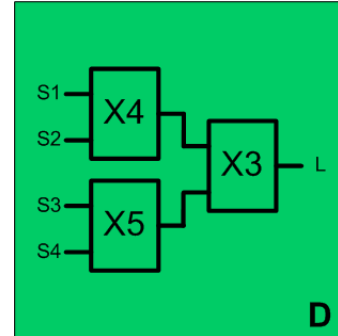


Table 4. Board D

No.	S1	S2	S3	S4	Main Lamp (L)
1	OFF	OFF	OFF	OFF	
2	OFF	OFF	OFF	ON	
3	OFF	OFF	ON	OFF	
4	OFF	OFF	ON	ON	
5	OFF	ON	OFF	OFF	
6	OFF	ON	OFF	ON	
7	OFF	ON	ON	OFF	
8	OFF	ON	ON	ON	
9	ON	OFF	OFF	OFF	
10	ON	OFF	OFF	ON	
11	ON	OFF	ON	OFF	
12	ON	OFF	ON	ON	
13	ON	ON	OFF	OFF	
14	ON	ON	OFF	ON	
15	ON	ON	ON	OFF	
16	ON	ON	ON	ON	

(Score 4)

Name: _____; Country: _____

Question 3:

Use the Table 4 to answer the following questions:

(a) What is the logic of X4, is it “AND” or “OR”?

(Score 1)

(b) What is the logic of X3, is it “AND” or “OR”?

(Score 1)

(c) What is the logic of X3, is it “AND” or “OR”?

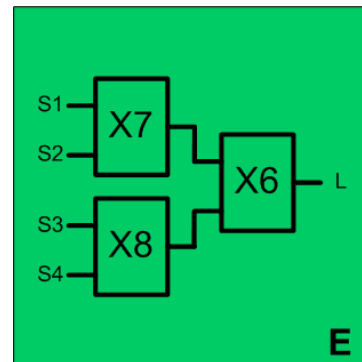
(Score 1)

ACTIVITY 5

You are requested to find the unknown logics (X6, X7 and X8) on Board E.

1. Remove Board D and plug in Board E.
2. Repeat Activity 1 by using S1, S2, S3 and S4.

(You could use a table if necessary)



Name: _____; Country: _____

Question 4:

(a) What is the logic of X6, is it “AND” or “OR”?

(Score 1)

(b) What is the logic of X7, is it “AND” or “OR”?

(Score 1)

(c) What is the logic of X8, is it “AND” or “OR”?

(Score 1)

ACTIVITY 6

In this activity, you are requested to fill in the blank in the Table 6, based on the combination of two “OR” logics and one “AND” logic as shown below.

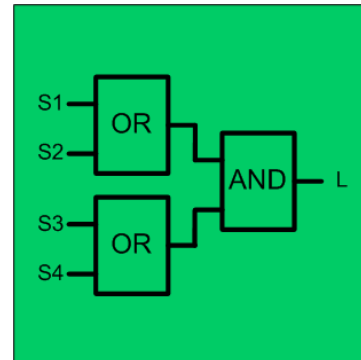


Table 6.

No	S1	S2	S3	S4	Main Lamp (L)
1	OFF		ON	OFF	OFF
2	ON	OFF	ON	OFF	
3	ON	ON		ON	OFF

(Score 3)

Name: _____; Country: _____

ACTIVITY 7

In this activity, you are requested to fill in the blank in the Table 7 based on the combination of one “**OR**” logic and two “**AND**” logics as shown in the diagram below.

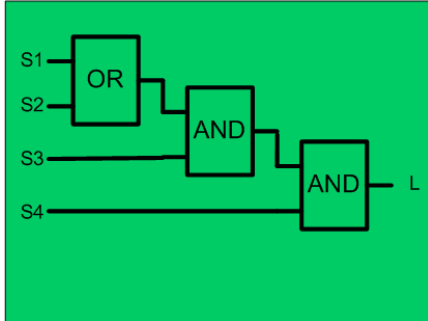


Table 7

No.	S1	S2	S3	S4	Main Lamp (L)
1					ON
2					ON
3					ON

(Score 6)

ACTIVITY 8

1. Unplug Board E and plug in Board Z into the socket in the main board properly.
2. The Buzz will create a sound only for a single combination of switches S1, S2, S3 and S4. In this activity, you have to find the right combination for the switches by writing “ON” and “OFF” in the table below.

S1	S2	S3	S4	Buzz
				ON

(Score 2)

Name: _____; Country: _____

Playing with Yeast Ball

Introduction

Fermentation is a process to break down organic material such as fat, carbohydrate and protein into more simple substances. Fermentation in general is caused by microorganisms such as yeast, bacteria or fungus. Fermentation needs organic materials and water to keep the microorganisms alive.

Temperature is also an important factor in the process of fermentation. For example, inactive yeast can be activated rapidly if fermentation condition occurs under approximately 40° Celsius.

The production of a gas during fermentation is caused by the types of substrate used. In most cases fermentation does not require oxygen so that an enclosed condition can be used for process.

Instruction

Materials and equipments

In this experiment you will be provided with **4** small containers. Three of them have a hole on their lid. One of the containers contains color indicator. You can put the indicator into the plastic tube by tapping the tip of the plastic tube into the color indicator. You can observe the fermentation activity based on movement of the indicator. Ignore if the color indicator contaminating your mixture, fermentation will not be affected!

Name: _____; Country: _____

A pen marker and a ruler can be used to mark the plastic tube. The markings on the plastic tube are used to measure the rate of fermentation. Make several markings on the plastic tube (refer to the tables given). A stop watch is also provided to measure the time.

Use 10 ml of warm water for each experiment by mixing hot water with fresh water in the plastic cup available. A thermometer is available to measure the fermentation temperature. **Beware of hot water!**

List of materials and equipment:

1. Small containers (3 pieces)
2. A container of color indicator
3. Plastic cups (2 pieces)
4. Plastic tubes (3 pieces, 1.5 meters each)
5. Spoons (4 pieces)
6. An adhesive tape
7. A vacuum flask of hot water
8. A bottle of freshwater
9. A Thermometer
10. A Stop watch
11. A Plastic measuring cylinder, 15 ml size
12. A cotton towel
13. Organic materials (Two packs: labeled A and B)
14. Two packs of yeast ball
15. A marker
16. Plasticine (toy clay)
17. Graph papers

Name: _____; Country: _____

PART A: Construct a fermentation device and prove that it works

Design a setup using materials and equipment available to show fermentation. Draw the setup on a paper and explain how it works. Use blank pages on the back of this exam paper if you need more space to draw and write explanation.

Answer (score 5):

Perform the experiments based on what you have designed. Use organic materials A, B and C to measure fermentation rate. Wait for 3 to 5 minutes before you measure the fermentation. Record your results in the tables.

Number of markings in your plastic tubes :

Distance between two markings :

(Score for data recording: 8 points)

Name: _____; Country: _____

Organic material A

Markings	Distance from starting point (cm)	Time (minutes)	Time (second)
0	0	0'00''	0
1			
2			
3			
4			
5			
6			
7			

Name: _____; Country: _____

Organic material B

0	0	0'00''	0
1			
2			
3			
4			
5			
6			
7			

Questions

a. What are the important material(s) and condition(s) needed for fermentation?

Answer:

Important material(s):

Condition(s):

(Score: 3)

Name: _____; *Country:* _____

- b. In this experiment, how do you mix your organic materials with warm water without contaminating the other setups?

Answer:

(Score 1)

- c. Why should you wait for 3 to 5 minutes before measuring the fermentation rate?

Answer:

(Score 1)

Name: _____; *Country:* _____

PART B: Analyze the effect of various organic material on the fermentation rate

a) Draw graphs from the results of each setup (distance vs. time) on the same axes using the millimeter block sheet.

(Score: 2)

b) Based on your graph what is the best organic material to be used for this fermentation reaction? Explain.

(Score: 2)